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Jueliger

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[54] **DEVICE IN A MOTOR VEHICLE FOR TRANSMITTING SIGNALS GENERATED BY MEANS OF A SENSOR**

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[52] **U.S. Cl.** **324/611**; 324/713; 324/705; 340/870.38; 340/904

[58] **Field of Search** 324/715, 713, 324/703, 705, 611; 340/870.38, 904

[56] **References Cited**

U.S. PATENT DOCUMENTS

Re. 30,603	5/1981	Grindheim	340/870.38
2,252,464	8/1941	Kearns	340/870.38
3,796,993	3/1974	Fox	340/870.38
4,071,823	1/1978	Okayama	340/870.38
4,803,420	2/1989	Steinbrecher	340/870.38

FOREIGN PATENT DOCUMENTS

3541 852 C2 6/1987 Germany .

OTHER PUBLICATIONS

Meyer H., Störfestigkeit von Meβsystemen, , Aug. 7, 1986.

Meyer–Brötz et al., Aufbau von Gleichspannungs–Differenzverstärkern mit hoher törspannungsunterdrückung, International Electronic Review, Series 18, 1965, Issue 11.

Laux, T., Störfaktoren im Visier., ELRAD 1994, Issue 3.

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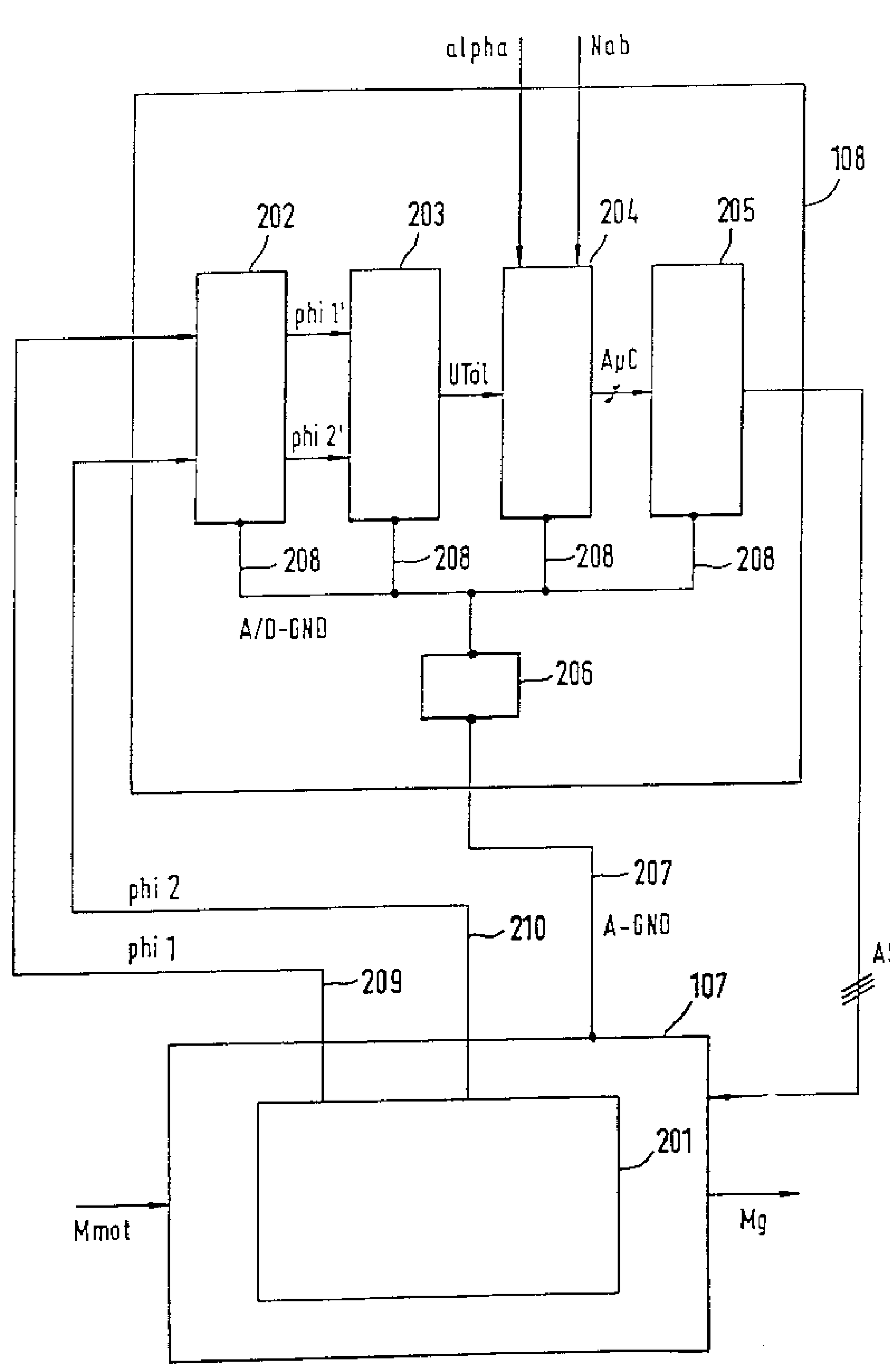
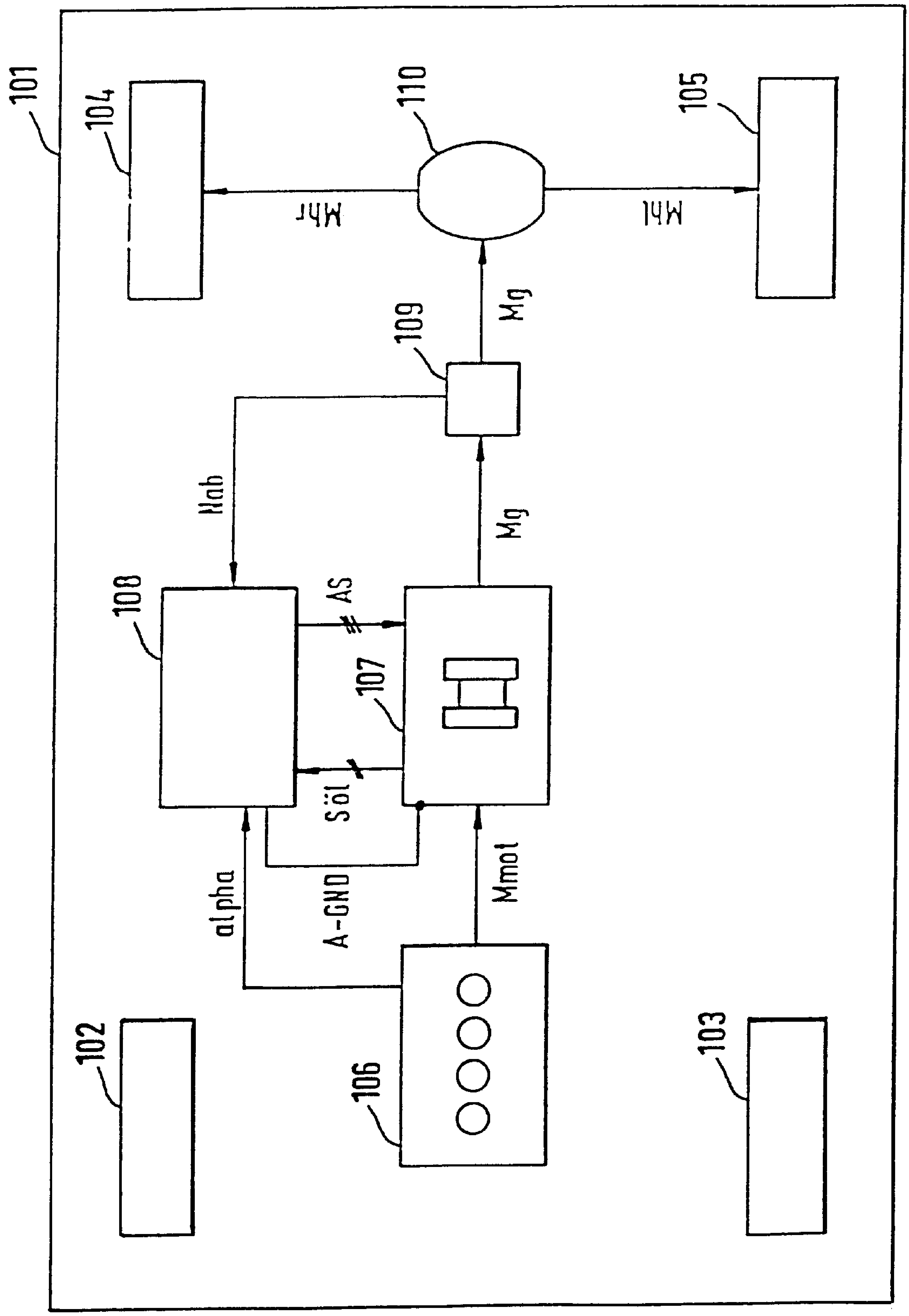
Attorney, Agent, or Firm—Kenyon & Kenyon

[57] **ABSTRACT**

A device in a motor vehicle, with which signals which are generated by a sensor and represent a physical magnitude are transmitted on signal lines. The device includes a voltage divider which is composed of the sensor and at least two impedances which are connected each at one end of the sensor. The signals generated by the sensor are guided, via signal lines connected at its terminals, to a differentiator, by which the usable signal is obtained, and interference signals coupled onto the signal lines are eliminated. Alternatively, the device can also be used for transmission on a signal line pair of any desired potential difference present at an impedance.

16 Claims, 5 Drawing Sheets

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Mhr
Mhl
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Mmot
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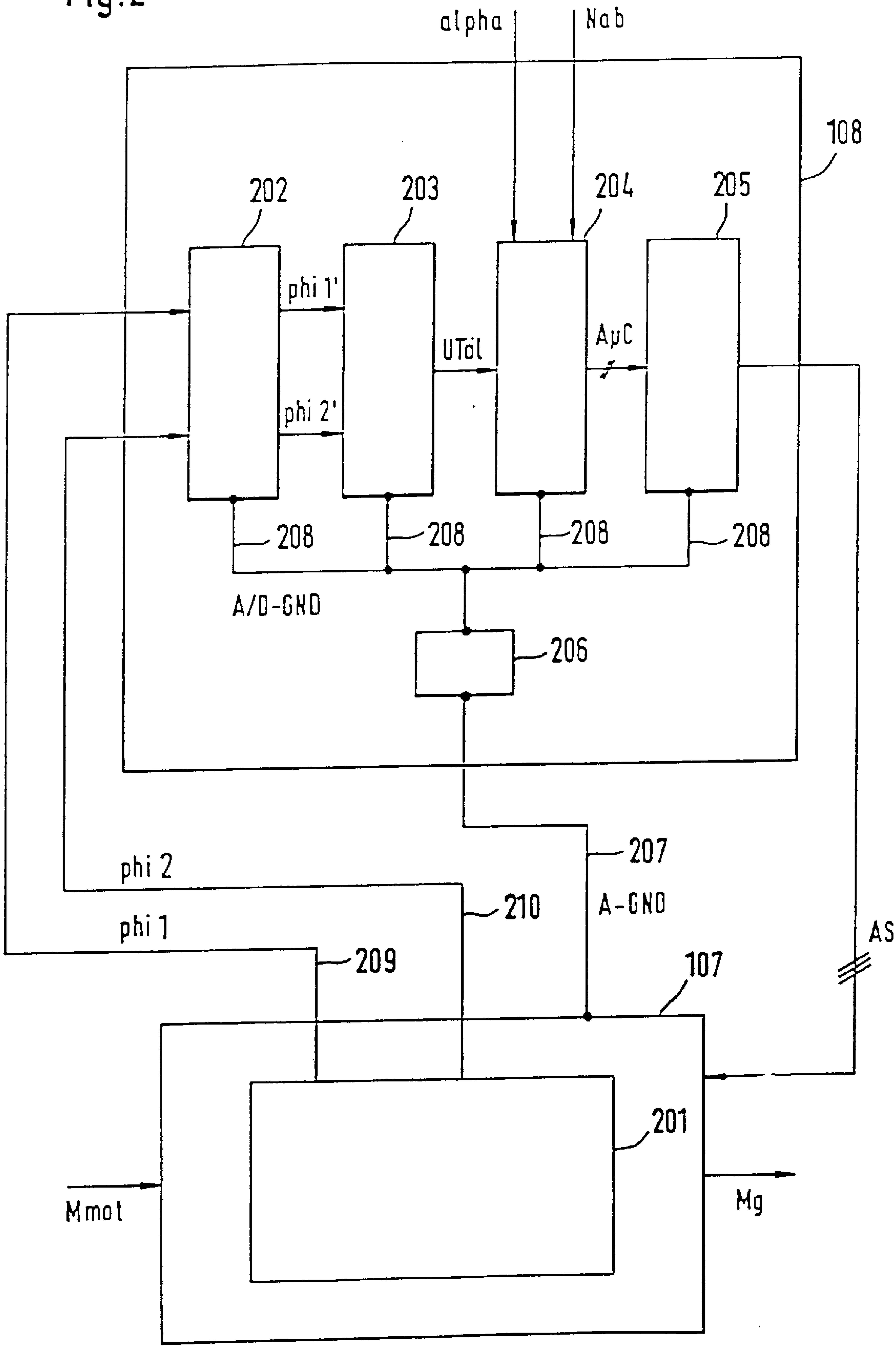
A-GND
106
102
103

Fig.1

Fig.2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phi 2'
UTol
AμC
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A/D-GND
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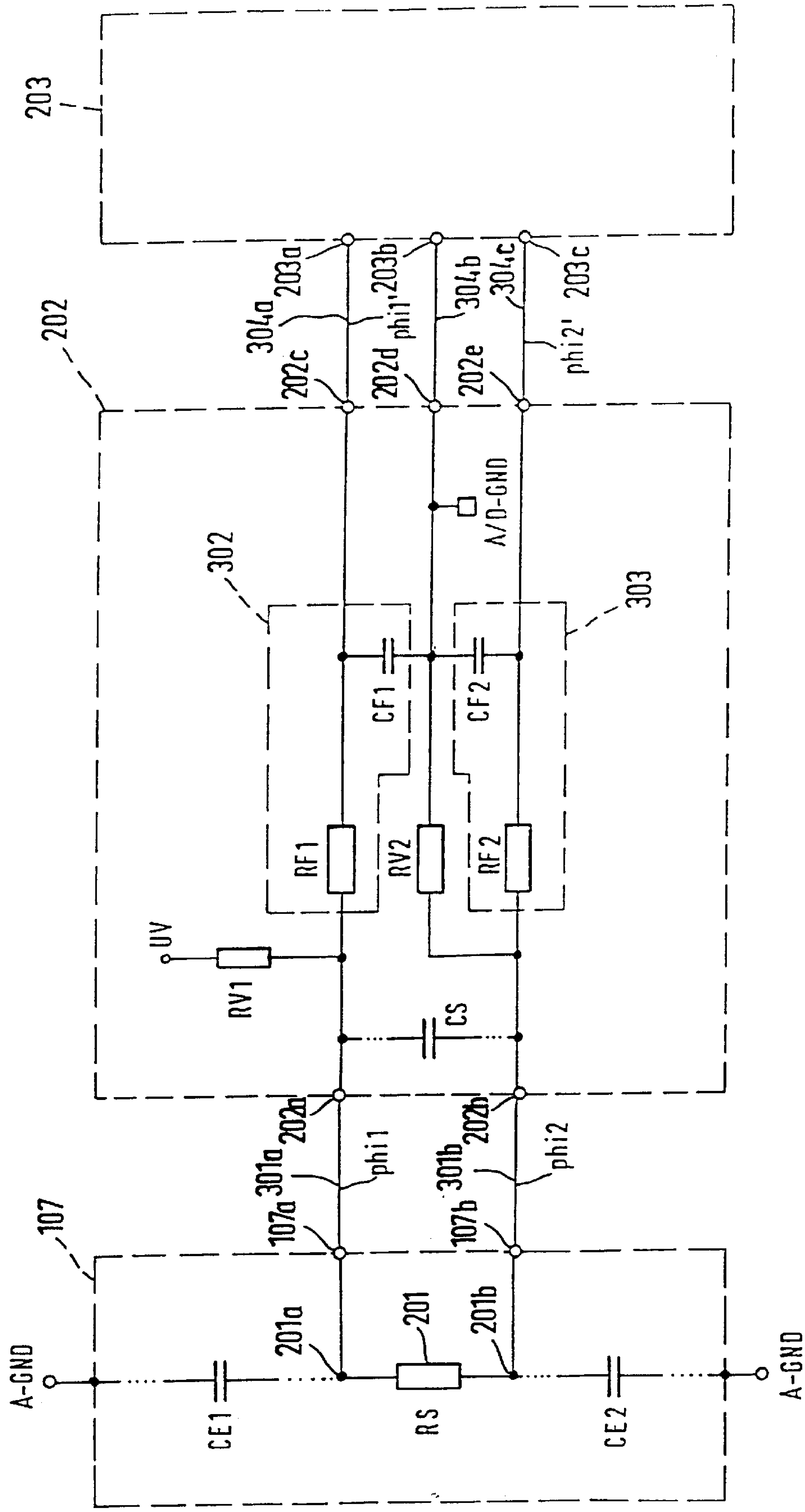
207
A-GND
phi 2
phi 1
210
209
AS
107
201
Mmot
Mg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203a
203b
203c
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304b
304c
phi1'
phi2'
202
202c
202d
202e
A/D-GND
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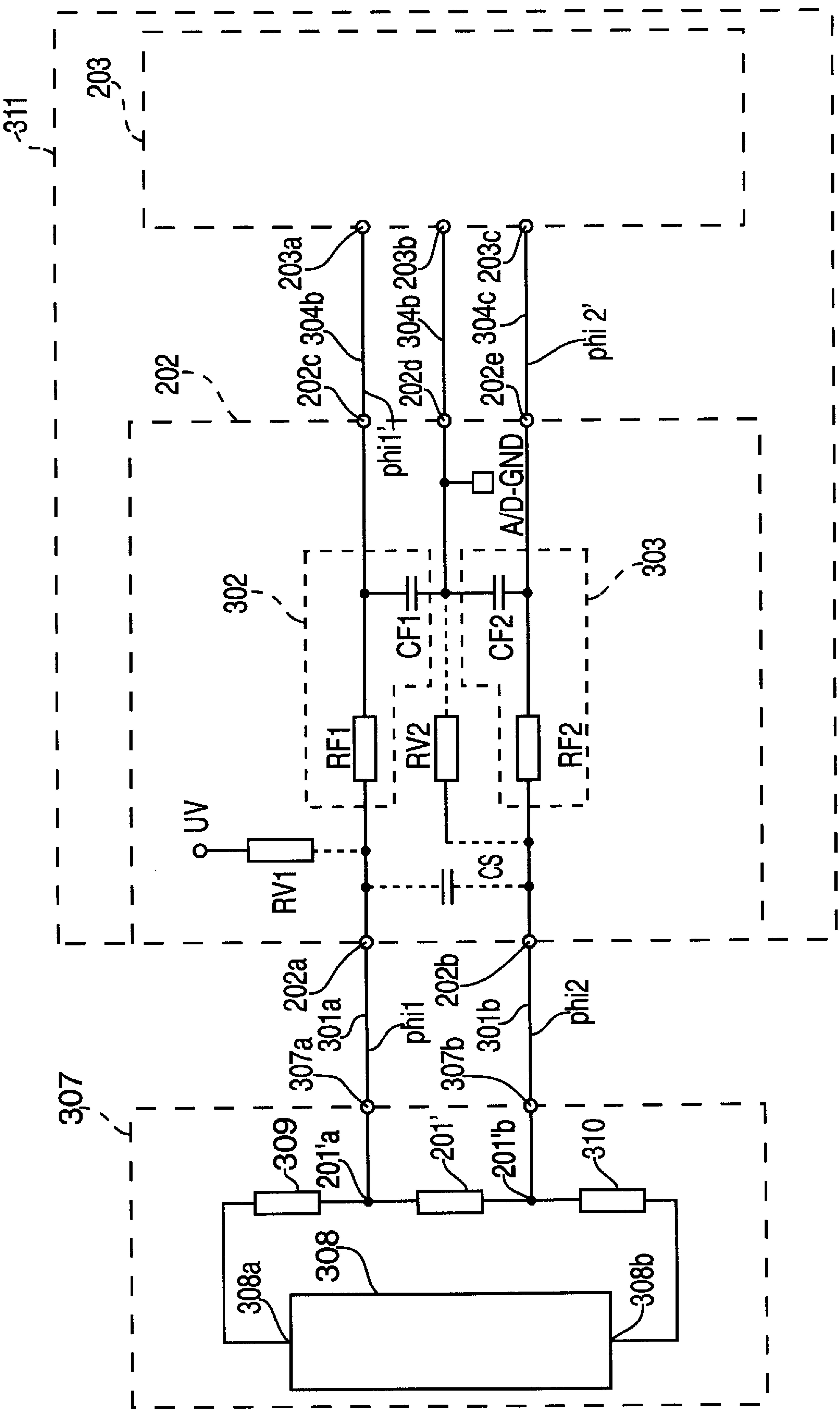
303
CF1
CF2
RF1
RV2
RF2
UV
RV1
CS
202a
202b
301a
301b
phi1
phi2
107
107a
107b
201
201a
201b
A-GND
CE1
RS
CE2
A-GND

Fig.3


311
203
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203b
203c
304b
304c
202
202c
202d
202e
phi1'
phi 2'
A/D-GND
302
303
CF1
CF2
RF1
RV2
RF2
UV
RV1
CS
202a
202b
301a
301b
phi1
phi2
307a
307b
307
309
201'a
201'
201'b
310
308
308a
308b

FIG. 4

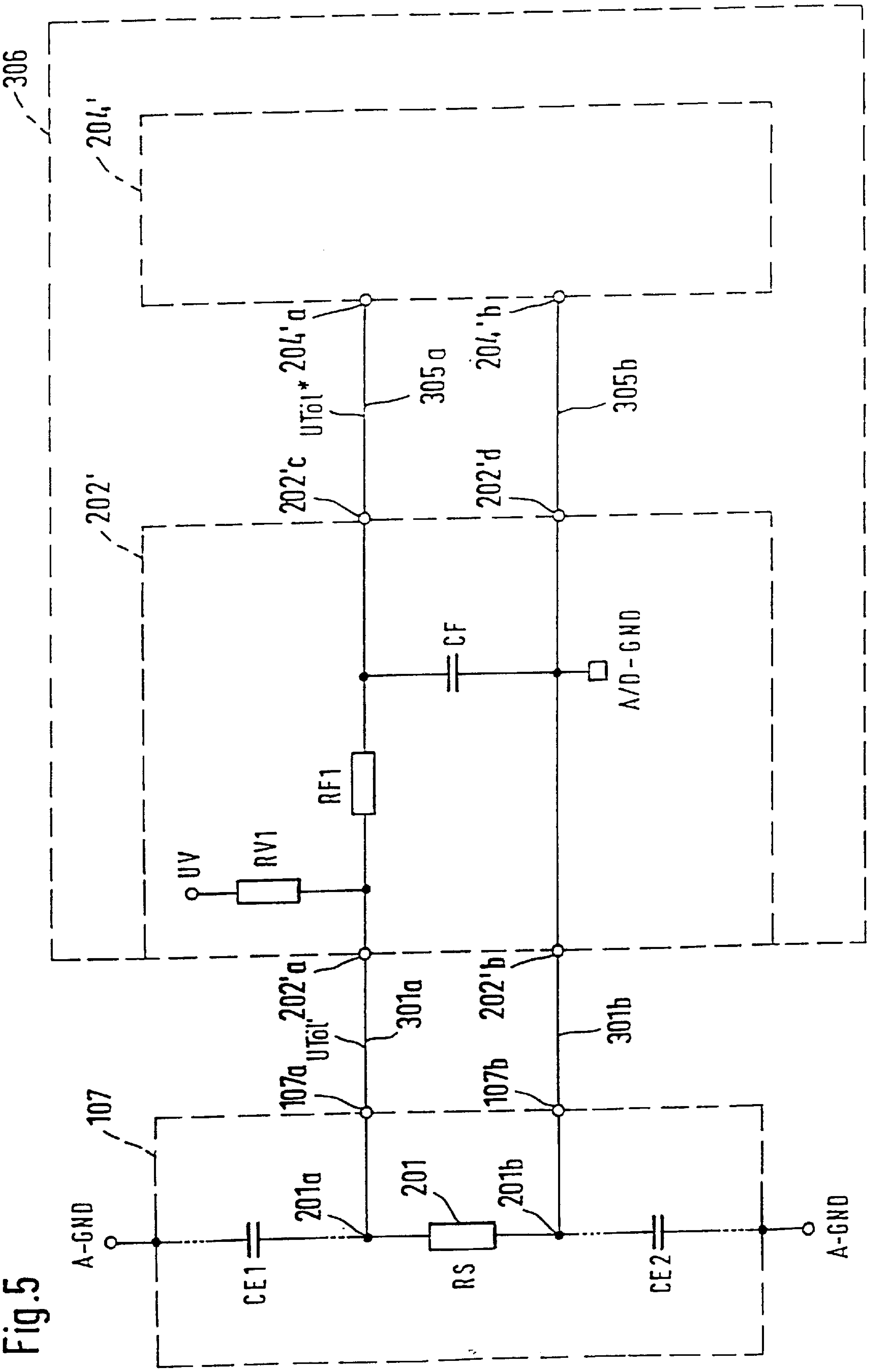
306
204'
204'a
204'b
305a
305b
UTol * 204'a
202'c
202'd
202'
CF
A/D-GND
RF1
UV
RV1
202'a
202'b
301a
301b
UTol'
107a
107b
107
A-GND
201a
201
201b
CE1
RS
CE2
A-GND

Fig.5

DEVICE IN A MOTOR VEHICLE FOR TRANSMITTING SIGNALS GENERATED BY MEANS OF A SENSOR

BACKGROUND OF THE INFORMATION

A large number of regulation and control systems are used today in automotive engineering. With many of these systems, it is necessary to sense various physical magnitudes by means of a sensor system, and convey them to the corresponding control device. An example that may be mentioned here is sensing of the oil temperature in the transmission, in the context of the transmission control system.

FIG. **5** shows a prior art circuit arrangement for a transmission control system in which the signal generated by the temperature sensor, which in this case represents the temperature of the oil in the transmission, is transmitted by means of two signal lines to the control device. To this end, there is mounted in the transmission (**107**) a sensor means (**201**) which is connected, via a first signal line (**301***a*) and a second signal line (**301***b*), to an input circuit (**202**') contained in a control device (**306**). Signal UTöl' generated by the sensor means is transmitted by means of the first signal line. The sensor means is connected to the ground A/D-GND of the control device via the second signal line. The input circuit consists of a component (RV**1**) which is used as a protective resistor, and of a filter which is made up of components RF**1** and CF. The input circuit is connected via a first signal line (**305***a*) and a second signal line (**305***b*) to a microcontroller (**204**'). Signal UTöl* is transmitted to the microcontroller by means of the first signal line. The second signal line connects the microcontroller to ground A/D-GND.

Since the transmission and the control device are arranged physically apart from one another in the vehicle, the signal lines must be routed outside the control device. As a result, interference signals can in some circumstances be coupled onto the two signal lines.

An arrangement for blanking out interference signals on signal lines is described in German Patent No. 42 22 475. In a first exemplifying embodiment, an arrangement is presented that can be used in the transmission of analog signals. In this context, the original signal is transmitted on a first signal line, and the time derivative of the original signal is transmitted on a second signal line. At the receiving end, the derived signal transmitted on the second signal line is integrated by means of an integrator. An analog AND instruction is applied to this integration signal and to the original signal transmitted on the first signal line. The interference signals coupled onto the transmission link are thereby eliminated. In a second exemplifying embodiment, an arrangement is presented which can be used in the transmission of digital signals. To this end, the original signal is transmitted on a first signal line, and the inverted original signal is transmitted on a second signal line. At the receiving end, the two signals are each digitized by means of a digitizing stage. The coupled-in interference is thus also present in digitized form. The digitized signal of the inverted original signal transmitted on the second signal line is inverted again at the receiving end. A logical AND instruction is applied to this signal and to the digitized signal of the original signal transmitted on the first signal line. The interference signals coupled onto the transmission link are thereby eliminated.

The arrangements in the first and the second exemplifying embodiment have the disadvantage that they must use not only very precisely operating components, but also components that are very well tuned to one another. If this is not the case, a certain proportion of the interference signal may still be present in the usable signal.

U.S. Pat. No. 3,906,384 describes an arrangement with which interference signals, which are overlaid on the usable signal during processing thereof in processing components, are eliminated. In an exemplifying embodiment, an arrangement is presented in which the usable signal is fed on the one hand unchanged to first processing components, and on the other hand in inverted form to second processing components. With the prerequisite that the first and the second processing components are identical, the same interference is then superimposed on the signals present after processing by the processing components. The signals present after processing by the processing components are both fed to a subtracter. The interference caused by the processing components is thereby eliminated.

This arrangement has, however, the following disadvantages: On the one hand, implementation is complex because of the double processing components required. On the other hand, the processing components must be very well matched to one another, since the interference signals can be eliminated only if they are generated identically. In addition, the signal level of the usable signal is doubled by this arrangement.

It is the object of the present invention to improve the elimination of interference signals coupled onto the signal lines during the transmission of signals.

SUMMARY OF THE INVENTION

The present advantage of the invention as compared with the existing art cited initially is that the elimination of interference signals coupled onto the signal lines during the transmission of sensor signals is improved.

Further advantages of the present invention are evident from a comparison of the circuit arrangement according to the first exemplifying embodiment of the present invention (FIG. **3**) with the arrangement described in German Patent No. 42 22 475 and with the arrangement described in U.S. Pat. No. 3,906,384. The comparison shows that in order to implement elimination of the interference signals, fewer components are required for the circuit arrangement according to the invention than for the arrangements belonging to the existing art.

A further advantage of the circuit arrangement according to the invention in the first exemplifying embodiment is evident from the voltage divider, which is made up of component RV**1**, sensor means **201**, and component RV**2**. With the use of this voltage divider, signals phi**1**' and phi**2**', which must each be conveyed to an A/D converter for further processing with a microcontroller, are shifted toward those voltage or potential values which are advantageous for the processing being performed by the A/D converter. Since signals phi**1**' and phi**2**' are thus no longer located at the edge of the measurement range of the particular A/D converter, the conversion of signals phi**1**' and phi**2**' by the respective A/D converter is more precise, and the signal-to-noise ratio is greater. At the same time, because of the use of the voltage divider and the shift in signals phi**1**' and phi**2**' associated therewith, the usable signals can more easily be filtered out of those signals.

The circuit arrangement according to the present invention shown in FIG. **3** has two further advantages as compared with the circuit arrangement (FIG. **5**) belonging to the existing art.

On the one hand, the circuit arrangement according to the present invention offers a diagnostic capability with which conclusions can be drawn, from the signals transmitted to the differentiating, means, as to the type of fault that may be present. For example, if both signals have the same value, this indicates a failure of the sensor due to a short circuit. In addition, interruption of one of the two signal lines **301***a* or **301***b* can be detected by means of the value of the signals transmitted to the differentiating means.

On the other hand, if an interrupted signal line (**301***a* or **301***b*) is detected, it is possible on a substitution basis, with limited measurement reliability, to utilize the signal transmitted on the other, intact signal line for further processing.

A variety of sensor signals may be considered as sensor signals for which, by means of the circuit arrangement according to the present invention, elimination of the interference signals coupled onto the signal lines during transmission can be accomplished. These signals may, for example, be those generated by wheel rotation speed sensors, acceleration sensors, yaw rate sensors, steering angle sensors, pressure sensors, or temperature sensors. In addition, the circuit arrangement according to the present invention can be used with respect to any desired control units.

In addition, the circuit arrangement according to the present invention can be used not only for the elimination of interference signals coupled onto the signal lines during the transmission of sensor signals, but also, the circuit arrangement according to the invention, as shown by the second exemplifying embodiment (FIG. **4**), can be used in the elimination of interference signals that are coupled onto signal lines during the transmission of any potential difference over said lines.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a first exemplifying embodiment of the present invention.

FIG. **2** illustrates the first exemplifying embodiment of the present invention in further detail.

FIG. **3** depicts an exemplary circuit arrangement in accordance with the first exemplifying embodiment of the present invention.

FIG. **4** depicts a second exemplifying embodiment of the present invention.

FIG. **5** illustrates a prior art circuit arrangement.

DETAILED DESCRIPTION

The invention will now be described first with reference to a first exemplifying embodiment, by means of FIGS. **1** to **3**.

Illustrated in FIG. **1** is a vehicle **101** which comprises front wheels **102** and **103** as well as driven rear wheels **104** and **105**. Engine **106** is provided in order to drive rear wheels **104** and **105**. This generates drive torque Mmot which is conveyed to transmission **107**. Drive torque Mmot is converted by means of transmission **107** into torque Mg which is applied to differential **110**. The two torques Mhl and Mhr, with which rear wheels **105** and **104** are driven, are made available by means of differential **110**.

Since the measurement of the temperature of the oil in the transmission, in the context of the transmission control system, will be addressed as the first exemplifying embodiment on the basis of which the invention will be described, further components necessary for the transmission control system are illustrated in FIG. **1**.

Accordingly, FIG. **1** illustrates a include control device **108** with which the control system for transmission **107** is implemented. Also illustrated is a mechanism **109** with which transmission output speed Nab can be sensed. This transmission output speed Nab is conveyed as an input variable to control device **108**, in addition to a load-dependent variable alpha which characterizes, for example, the accelerator pedal position and/or the throttle valve angle. Also conveyed to control device **108** are signals Söl which describe the temperature of the oil in the transmission. As output signals, control device **108** outputs signals AS by means of which transmission **107** is controlled. The housing of transmission **107** is connected by means of line A-GND to ground A-GND of control device **108**, thus grounding the housing of transmission **107**.

FIG. **2** depicts in more detail exemplary components in accordance with the first exemplifying embodiment of the present invention. **107** designates the transmission, which converts torque Mmot generated by the engine into torque Mg. Transmission **107** contains a sensor means **201** for sensing the temperature of the oil in the transmission.

Control device **108** contains, for example, the following components: input circuit **202**, differentiating means **203**, microcontroller **204**, output circuit **205**, and power supply filter **206**.

The housing of transmission **107** is connected via line **207** to power supply filter **206**. The housing of the transmission is thus connected to ground A-GND. Components **202**, **203**, **204**, and **205** of control device **108** are also connected, via line **208**, to power supply filter **206**. They are thereby connected to ground A/D-GND. The power supply filter ensures that the two grounds A-GND and A/D-GND are decoupled as completely as possible from one another.

Sensor means **201** for sensing the temperature of the oil in transmission **107** is connected via signal lines **209** and **210** to input circuit **202**. Signal phi**1** is transmitted by means of signal line **209**, and signal phi**2** by means of signal line **201**, from sensor means **201** to input circuit **202**.

Input circuit **202** forms output signal phi**1**' from input signal phi**1**. Similarly, it forms output signal phi**2**' from input signal phi**2**. The two signals phi**1**' and phi**2**' are input signals to differentiating means **203**. On the basis of the two input signals phi**1**' and phi**2**', differentiating means **203** generates difference signal UTöl which is a direct indication of the oil temperature in transmission **107**.

Differentiating means **203** can be implemented in various ways. For example, it can be implemented in the form of an analog subtracting amplifier, to which the analog input signals phi**1**' and phi**2**' are conveyed. On the basis of these two signals, the analog subtracting amplifier forms analog difference signal UTöl. This is conveyed as input signal to microcontroller **204**. In order for microcontroller **204** to be able to process analog input signal UTöl, it must convert it internally into a corresponding digital signal by means of an A/D converter.

On the other hand, differentiating means **203** can also form the difference between input signals phi**1**' and phi**2**' digitally. For this purpose, both input signals phi**1**' and phi**2**' must, before processing in differentiating means **203**, each be converted into digital signals by means of an A/D converter.

Using an appropriate subtraction algorithm, differentiating means **203** forms the digital output signal UTöl. This is forwarded to microcontroller **204** as the input signal. In this case, A/D conversion of the input signal in microcontroller

204 is not necessary. The A/D converters necessary for conversion prior to processing in differentiating means **203** can be either A/D converters of microcontroller **204**, or discrete A/D converters.

As a function of the input signals UTöl, alpha, and Nab, microcontroller **204** generates output signals AμC. These are sent as input signals to output circuit **205**.

Output circuit **205** represents essentially an amplifier circuit with which input signals AμC are converted into activation signals for controlling the transmission. Activation signals AS are used to activate actuators, located in transmission **107**, with which transmission **107** is influenced.

For a further advantageous configuration of the exemplifying embodiment, it is possible, in some circumstances, to amplify signals phi**1** and phi**2** and/or phi**1**' and phi**2**' and/or UTöl, using additional components, before they are respectively processed in the corresponding units.

FIG. **3** shows a circuit arrangement according to the invention which is used in the context of the transmission control system to measure the temperature of the oil in the transmission, and with which the interference signals coupled onto the signal lines are eliminated.

For this purpose, a sensor means **201** is inserted in transmission **107** in order to sense the temperature. This sensor means **201** can, for example, be a temperature-dependent resistor RS whose resistance changes as a function of the oil temperature. Terminal **201***a* of sensor means **201** is connected to terminal **107***a* attached in insulated fashion on transmission **107**. Terminal **201***b* of sensor means **201** is correspondingly connected to terminal **107***b*, also attached in insulated fashion on transmission **107**. The housing of transmission **107** is connected in conductive fashion to ground A-GND.

It can be particularly advantageous if terminals **201***a* and **201***b* of sensor means **201** are each connected via capacitors CE**1** and CE**2** to the housing of transmission **107**. For this purpose, the one terminal of capacitor CE**1** is connected to terminal **201***a* of sensor means **201**. The other terminal of capacitor CE**1** is connected to the housing of transmission **107**. In addition, the one terminal of capacitor CE**2** is connected to terminal **201***b* of sensor means **201**, and the other terminal of capacitor CE**2** to the housing of transmission **107**.

Since connection of the two terminals **201***a* and **201***b* of sensor means **201**, each via one of the two capacitors CE**1** and CE**2**, to the housing of transmission **107**, is not absolutely necessary in terms of converting the idea of the invention into a circuit arrangement according to the invention, the connections of the two capacitors CE**1** and CE**2** to sensor means **201** and to the housing of transmission **107** are indicated in FIG. **3** with dashed lines.

In addition, it can further be advantageous if the two capacitors CE**1** and CE**2** are housed not in transmission **107**, but in control device **108**, in particular in input circuit **202**. The assignment of the terminals of the two capacitors CE**1** and CE**2** to terminals **201***a* and **201***b* of sensor means **201**, and to ground A-GND, remains unchanged in this context. The connection of sensor means **201** to the two capacitors CE**1** and CE**2** must, however, be implemented in this case via signal lines **301***a* and **301***b*. In addition, the two capacitors CE**1** and CE**2** must be connected in control device **108**, in particular in input circuit **202**, to ground A-GND.

Terminal **107***a* attached on transmission **107** is connected via signal line **301***a* to terminal **202***a* of input circuit **202**. Terminal **107***b* of transmission **107** is connected via signal line **301***b* to terminal **202***b* of input circuit **202**. By means of signal line **301***a*, the signal phi**1** generated by sensor means **201** is transmitted from sensor means **201**, and thus from transmission **107**, to input circuit **202**. Correspondingly, by means of signal line **301***b*, the signal phi**2** generated by sensor means **201** is transmitted to input circuit **202**.

Input circuit **202** contains substantially the components RV**1**, RV**2**, CS, and the modules **302** and **303**.

Component RV**1** is connected at its one end to terminal **202***a*. Connected at the other end of component RV**1** is a supply voltage UV. Component RV**2** is connected at its one end to terminal **202***b*. The other end of component RV**2** is connected to terminal **202***d*. At the same time, terminal **202***d* is connected in conductive fashion to ground A/D-GND.

Input circuit **202** contains the two modules **302** and **303**, drawn with dashed lines. Module **302** is inserted between signal lines **301***a* and **304***a* and **304***b*. Module **303** is inserted between signal lines **301***b* and **304***c* and **304***b*. Since both modules **302** and **303** are not necessary for converting the idea of the invention into a circuit arrangement according to the invention, they are depicted in FIG. **3** with dashed lines.

The two modules **302** and **303** represent filters which function identically with respect to the interference signals. In the specific exemplifying embodiment, modules **302** and **303** are implemented as low-pass filters.

Module **302**—the first low-pass filter—consists of a component RF**1** whose one end is connected to terminal **202***a*. The other end of component RF**1** is connected to terminal **202***c*. At the same time, this end of component RF**1** is also connected to one end of capacitor CF**1**. The other end of capacitor CF**1** is connected to terminal **202***d*.

Module **303**—the second low-pass filter—consists of components RF**2** and CF**2**. Component RF**2** is connected at its one end to terminal **202***b* and at its other end to terminal **202***e*. Capacitor CF**2** is connected at its one end to terminal **202***e* and at its other end to terminal **202***d*.

Components RF**1** and RF**2** are usually selected to be ohmic resistors. In order for the first and second low-pass filters to function identically with respect to the interference signals, the values of the two components RF**1** and RF**2** are selected to be identical. Similarly, in this case the two capacitors CF**1** and CF**2** have the same capacitance.

Terminal **202***c* of input circuit **202** is connected via signal line **304***a* to terminal **203***a* of differentiating means **203**. Terminal **202***d* of input circuit **202** is connected via signal line **304***b* to terminal **203***b* of differentiating means **203**. Terminal **202***e* of input circuit **202** is similarly connected via signal line **304***c* to input **203***c* of differentiating means **203**.

By means of signal line **304***a*, output signal phi**1**' of input circuit **202** is transmitted to differentiating means **203**. Output signal phi**2**' of input circuit **202** is transmitted via signal line **304***c* to differentiating means **203**. Differentiating means **203** is connected to ground A/D-GND via signal line **304***b*.

In the exemplifying embodiment, both module **302**—the first low-pass filter—and module **303**—the second low-pass filter—are each implemented by means of a first-order low-pass. It is also possible to utilize higher-order low-passes. In addition to the low-pass filter shown in the exemplifying embodiment, it is of course also possible to use other filter means.

For the case in which the two modules **302** and **303** may not, because of component tolerances, be of identical design, it is possible, by feeding one and the same signal onto the two signal lines **301***a* and **301***b*, to determine by means of a correction circuit upstream from differentiating means **203** the deviation generated in this special input signal because of the different design of the two modules **302** and **303**. If this deviation is known, it can be eliminated by means of the correction means, and the design differences between the two modules **302** and **303** can be compensated for.

The filters implemented by means of modules **302** and **303** are not absolutely necessary for converting the idea of the invention into a circuit arrangement according to the invention. For this reason they can, but do not need to, be taken into account in the circuit arrangement according to the invention.

The selection of components RV**1** and RV**2**, which are impedances, is based on the type of sensor means **201**. If sensor means **201** is a sensor which changes its ohmic resistance as a function of the physical magnitude being measured, then ohmic resistors are usually selected as components RV**1** and RV**2**. If sensor means **201** is a sensor which changes its inductivity or capacitance as a function of the physical magnitude being measured, then inductors or capacitors are usually selected as components RV**1** and RV**2**.

The physical magnitude being measured can be, for example, a temperature, a pressure, a wheel rotation speed, or an acceleration.

Instead of the individual component RV**1** or individual component RV**2**, it is also possible to use in each case a network, consisting of multiple components, in which parallel or series circuits are implemented by the components.

In some circumstances it can be advantageous if the two components RV**1** and RV**2** have the same value. The voltage divider consisting of component RV**1**, sensor means **201**, and component RV**2** is thus of symmetrical construction. This may possibly be advantageous for the processing of the two signals phi**1**' and phi**2**' in differentiating means **203**.

If, however, it should be advantageous in terms of an arrangement to select an asymmetrical voltage divider, this can be achieved by suitable selection of components RV**1** and RV**2**.

Utilization of the circuit arrangement according to the invention, in the context of the transmission control system, in the measurement of the temperature of the oil in the transmission represents no limitation on the use of this circuit arrangement according to the invention. The circuit arrangement according to the invention can be used with respect to any desired sensor. For example, these can be steering angle sensors, sensors for detecting wheel speed, yaw rate sensors, acceleration sensors, or pressure sensors. The circuit arrangement according to the invention can be used both for passive and for active, e.g. current-generating, sensors.

Use of the circuit arrangement according to the invention is also not limited to use with the transmission control system. Rather it can be used with respect to any desired control devices. For example, these can be control devices for the engine control system, control devices for antilock braking systems, control devices for automatic slip control systems, or control devices for vehicle dynamics regulation.

A further advantageous embodiment of the circuit arrangement according to the invention results when capacitor CS is connected at the input of input circuit **202** at terminals **202**_a_ and **202**_b_. This capacitor CS filters the two signals phi**1** and phi**2** generated by sensor means **201**. Since this capacitor CS is not absolutely necessary for conversion of the underlying idea of the invention into a circuit arrangement, its connections to terminals **202**_a_ and **202**_b_ are indicated with dashed lines.

A second exemplifying embodiment will be indicated below. FIG. **4** shows a circuit arrangement according to the invention for this second exemplifying embodiment.

The circuit arrangement according to the invention in the second exemplifying embodiment is also a device that is used in a motor vehicle. With it, interference signals that are coupled onto a signal line pair during the transmission of any desired potential difference by means thereof can be eliminated. A potential difference being transmitted can be, for example, a potential difference that is proportionally related to the output voltage of an output circuit of a control device.

As FIG. **4** shows, the circuit arrangement according to the invention is intended to eliminate interference signals which, during the transmission of the potential difference between control device **307** and control device **311** using a signal line pair, are coupled onto said signal line pair. The potential difference is described by the two signals phi**1** and phi**2**. The two signal lines **301**_a_ and **301**_b_ constitute the signal line pair.

For this purpose, the voltage divider consisting of impedances **309**, **201**', and **310** is connected to output circuit **308** of control device **307**. The one end of impedance **309** is connected to terminal **308**_a_ of output circuit **308**. The other end of impedance **309** is connected on the one hand to terminal **307**_a_ of control device **307**, and on the other hand to terminal **201**'_a_ of impedance **201**'. Terminal **201**'_b_ of impedance **201**' is simultaneously connected to terminal **307**_b_ of control device **307** and to the one end of impedance **310**. The other end of impedance **310** is connected to terminal **308**_b_ of output circuit **308**.

Signal line **301**_a_ connects terminal **307**_a_ of control device **307** to terminal **202**_a_ of input circuit **202** of control device **311**. By means of control line **301**_b_, output **307**_b_ of control device **307** is connected to terminal **202**_b_ of input circuit **202** of control device **311**.

Processing of the two signals phi**1** and phi**2** in input circuit **202** corresponds to the description given in the first exemplifying embodiment.

Since the potential difference to be transmitted by means of the signal line pair in the second exemplifying embodiment is not one generated by a sensor, components RV**1** and RV**2**, and the supply voltage, can be dispensed with in input circuit **202**. They can, however, also be retained if an advantageous configuration in the second exemplifying embodiment should result therefrom. This is indicated in FIG. **4** by the dashed lines at the terminals of components RV**1** and RV**2**.

Since output circuit **308** of control device **307** generates an output voltage at its terminals **308**_a_ and **308**_b_, these terminals are referred to as voltage terminals. The potential difference described by signals phi**1** and phi**2** is proportional to the output voltage generated by output circuit **308** of control device **307**.

In the case of the circuit arrangement according to the invention shown in FIG. **4**, it may certainly also be advantageous for impedance **201**' arranged between signal lines **301**_a_ and **301**_b_ also to be arranged in control device **311** rather than in control device **307**.

In general, it can be assumed that the invention concerns a device in a motor vehicle for transmitting a potential difference via at least one signal line pair. The potential difference can, in this context, occur at a sensor or at an impedance. The sensor or impedance is in each case part of a voltage divider between supply voltage terminals or voltage terminals. A signal line is connected at each terminal of the impedance or of the sensor. The other end of the signal lines is guided to a differentiating means.

What is claimed is:

1. A device in a motor vehicle for transmitting a potential difference over at least one signal line pair and with which interference signals coupled onto the at least one signal line pair during a transmission of the potential difference are eliminated, comprising:

a voltage divider, the voltage divider having a first end and a second end and including at least a first impedance having a first terminal and a second terminal, a second impedance coupled to the first terminal and a third impedance coupled to the second terminal, the first end of the voltage divider coupled to a first voltage terminal of an output circuit, and the second end of the voltage divider coupled to a second voltage terminal of the output circuit, the first impedance having the potential difference;

a differentiator; and

at least one signal line pair, the at least one signal line pair including a first signal line and a second signal line, each of the first signal line and the second signal line having a first end and a second end, the first end of the first signal line being coupled to the first terminal, the second end of the first signal line being coupled to the differentiator, the first end of the second signal line being coupled to the second terminal, and the second end of the second signal line being coupled to the differentiator, wherein, according to the potential difference, the first signal line has a first potential and the second signal line has a second potential, and wherein the differentiator forms a difference between the first potential and the second potential.

2. The device according to claim 1, further comprising:

a first filter coupled to the first signal line, the first filter filtering interference signals on the first signal line, and

a second filter coupled to the second signal line, the second filter filtering interference signals on the second signal line, the second filter functioning identically to the first filter.

3. The device according to claim 2, wherein each of the first filter and the second filter includes a low-pass filter.

4. The device according to claim 1, wherein the differentiator includes an analog subtractor.

5. The device according to claim 1, further comprising:

a digitizer, coupled to the differentiator, the first signal line, and the second signal line, the digitizer digitizing signals on the first signal line and second signal line and providing the digitized signals to the differentiator.

6. A device in a motor vehicle for transmitting signals and with which interference signals coupled onto signal lines during a transmission of the signals are eliminated, the signals being generated by a sensor, the signals representing a physical magnitude, the sensor constituting a voltage divider and including a first terminal and a second terminal, comprising:

a voltage divider including the sensor, a first impedance, and a second impedance, the sensor coupled to the first impedance at the first terminal, and the sensor coupled to the second impedance at the second terminal, the voltage divider having a first end and a second end, the first end of the voltage divider coupled to a first voltage terminal, and the second end of the voltage divider coupled to a second voltage terminal;

a differentiator;

a first signal line having a first end and a second end, the first end of the first signal line coupled to the first terminal of the sensor, and the second end of the first signal line coupled to the differentiator; and

a second signal line having a first end and a second end, the first end of the second signal line coupled to the second terminal of the sensor, and the second end of the second signal line coupled to the differentiator, wherein the differentiator forms a difference between a signal on the first signal line and a signal on the second signal line.

7. The device according to claim 6, further comprising:

a first filter coupled to the first signal line, the first filter filtering interference signals on the first signal line, and

a second filter coupled to the second signal line, the second filter filtering interference signals on the second signal line, the second filter functioning identically to the first filter.

8. The device according to claim 7, wherein each of the first filter and the second filter includes a low-pass filter.

9. The device according to claim 6, wherein the voltage divider has a symmetrical configuration, and wherein the first impedance and the second impedance have identical impedance values.

10. The device according to claim 6, wherein the differentiator includes an analog subtractor.

11. The device according to claim 6, further comprising:

a digitizer, coupled to the differentiator, the first signal line, and the second signal line, the digitizer digitizing signals on the first signal line and second signal line and providing the digitized signals to the differentiator.

12. The device according to claim 6, wherein the sensor has an ohmic resistance, the ohmic resistance changing as a function of the physical magnitude.

13. The device according to claim 6, wherein the sensor has at least one of a capacitative value and an inductive value, the at least one of the capacitative value and the inductive value changing as a function of the physical magnitude.

14. The device according to claim 6, wherein the physical magnitude is an oil temperature in a transmission control system.

15. The device according to claim 1, further comprising:

a housing;

a first capacitor; and

a second capacitor, wherein:

the voltage divider includes a sensor having a first terminal coupled to the first terminal of the voltage divider and a second terminal coupled to the second terminal of the voltage divider,

the first capacitor includes a first terminal coupled to the first terminal of the sensor and a second terminal coupled to the housing, and

the second capacitor includes a first terminal coupled to the second terminal of the sensor and a second terminal coupled to the housing.

16. The device according to claim 6, further comprising:

a housing;

a first capacitor; and

a second capacitor, wherein:

the first capacitor includes a first terminal coupled to the first terminal of the sensor and a second terminal coupled to the housing, and

the second capacitor includes a first terminal coupled to the second terminal of the sensor and a second terminal coupled to the housing.

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